ISSN 1809-127X (online edition)
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Journal of species lists and distribution

Vascular plants of oxbow lakes of Turvo River, Upper Paraná River basin, São Paulo State, Brazil

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Abstract: Vascular plants were investigated in oxbow lakes of Turvo River, Upper Paraná River basin, between Icém and Nova Granada municipalities, state of São Paulo, Brazil. In this region, six lagoons were sampled: Ganzella, Mustafá, Braço Morto, 45, Federal, and Parente. The survey showed a total of 54 species, 36 genera and 22 families. The species richest families were Poaceae, Cyperaceae, and Polygonaceae. *Eichhornia crassipes* (Pontederiaceae) was the single species encountered in all the six lakes.

Introduction

Oxbow lakes are recognized for their importance in the maintenance and integrity of regional biodiversity, as natural nurseries of commercially important species (Agostinho *et al.* 2000), and as a preferential habitat of sedentary and small-sized fish species (Meschiatti *et al.* 2000; Araujo and Langeani 2006). These areas are colonized by aquatic and marginal vegetation that establish strong connection between aquatic and terrestrial ecosystems, play an important role in the primary production, nutrient cycling, and as bioindicators of eutrophication processes (Scheffer 1998). Regarding the aquatic macrophytes from Upper Paraná River basin floodplain, Thomaz *et al.* (2004) registered a total of 60 species in rivers, channels, backwaters, and permanent and temporary lagoons. In this same region, Santos and Thomaz (2007) found 29 species of aquatic plants in seven lagoons. Recently, Amaral *et al.* (2008) listed 400 species of aquatic flora of the state of São Paulo.

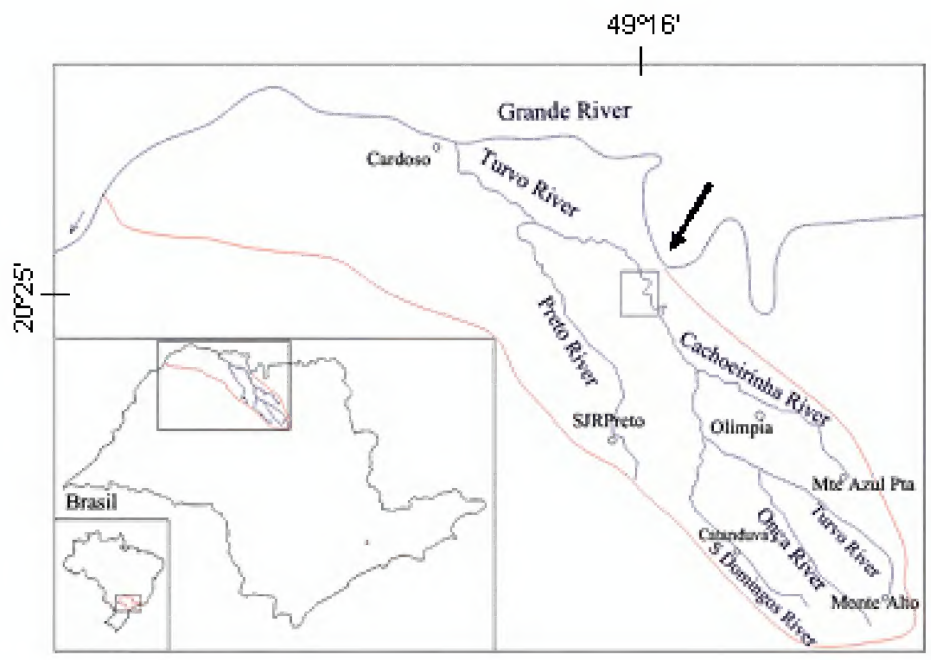

Figure 1. Turvo-Grande hydrographic basin showing localization of the study area. The arrow indicates collecting site in the Turvo River, São Paulo, Brazil.

Composition of vascular plants of oxbow lakes of Turvo River, Upper Paraná River basin is still unknown. The purpose of this study is to provide a species list of this habitat, the first investigation of the kind in this region.

Materials and Methods

The Turvo River basin is part of the large Grande River drainage basin, which belongs to the Upper Paraná River basin. The headwaters of the Turvo River are located in the municipality of Monte Alto and its mouth is located in the city of Cardoso, both in the state of São Paulo. The main tributaries of the Turvo River include Onça, Preto, São Domingos, and Cachoeirinha rivers (Figure 1).

Samplings were performed from July 2005 to May 2007 in six oxbow lakes along the Turvo River, 20°21'11" S, 49°16'38" W, near Km 12 of BR-153 highway between Nova Granada and Icém municipalities, state of São Paulo (Figure 1). Material was collected under the Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis permits (#03/2005, 12/2006). Vascular plants (aquatic and marginal macrophytes) were manually sampled in the Ganzella (G), Mustafá (M), Braço Morto (BM), 45 (L45), Federal (F), and Parente (P) lakes (Table 1, Figures 2-7). The identification of species was done using specialized literature and by comparison with SJRP herbarium exsiccates previously identified by specialists. The taxonomic classification is according to the Angiosperm Phylogeny Group II (APG II 2003) and Windisch (1992). Voucher specimens of each species are deposited in the Herbário SJRP of the Departamento de Zoologia e Botânica, Instituto de Biociências, Letras e Ciências Exatas, Universidade Estadual Paulista (UNESP).

Results and Discussion

A total of 54 species distributed in 36 genera and 22 families were collected in the oxbow lakes of Turvo River (Table 2). This number of species represents *ca.* 14 % of the 400 species of aquatic flora listed by Amaral

et al. (2008) for the state of São Paulo, suggesting that it is necessary to preserve these environments. Families Poaceae, Cyperaceae, and Polygonaceae were the most representative with eight, six, and five species, respectively, totalizing 34.5 % of the species found. *Eichhornia crassipes* (Pontederiaceae) was the only species found in the six lakes. It is native from the Amazon and Pantanal regions occurring in all regions of Brazil (Amaral *et al.* 2008).

The Parente lake was the species richest (25), followed by Ganzella (22) and Federal lake (19). Considering the importance of marginal lakes in the maintenance and integrity of regional biodiversity in terms of fishes (Delariva *et al.* 1994; Araujo and Langeani 2006), amphibians, reptiles, birds, and mammals (O.A.B. Azevedo, pers. comm.) the results obtained in oxbow lakes of Turvo River could be useful because can contribute with valuable data for the study of possible interactions with the fauna species.

Figure 2. Lake Ganzella, Turvo River, Nova Granada, SP, Brazil (September 16, 2005). Photo: R. B. Araujo

Figure 3. Lake Mustafá, Turvo River, Nova Granada, SP, Brazil (July 13, 2005). Photo: R. B. Araujo

Figure 4. Lake Braço Morto, Turvo River, Nova Granada, SP, Brazil (July 13, 2005). Photo: R. B. Araujo

Figure 5. Lake 45, Turvo River, Icém, SP, Brazil (September 23, 2005). Photo: R. B. Araujo

Figure 6. Lake Federal, Turvo River, Nova Granada, SP, Brazil (July 28, 2005). Photo: R. B. Araujo

Figure 7. Lake Parente, Turvo River, Icém, SP, Brazil (September 23, 2005). Photo: R. B. Araujo

TABLE 1. Environmental parameters for the six studied oxbow lakes of Turvo River. *M was desiccated.

Lake	Coordinates	Altitude (m)	Area (m^2)	Depth (m)
G	20°25'11.9"S 49°16'00.1"W	459	6,887	0.05-1.7
M	20°24'37.9"S 49°16'05.3"W	454	12,584	* - 1.6
BM	20°21'11.6"S 49°16'39.0"W	432	27,680	0.4-1.8
L45	20°24'56.1"S 49°15'53.7"W	456	22,798	0.6-2.7
F	20°22'45.6"S 49°16'36.1"W	441	48,587	0.65-3.0
P	20°21'30.1"S 49°16'48.6"W	436	124,442	0.1-2.8

TABLE 2. Vascular plants species found in six oxbow lakes of Turvo River, Upper Paraná River basin, from 2005 to 2007. Herbarium SJRP number (SJRP nº).

Family/Species	Lake	SJRP number
Amaranthaceae		
Alternanthera pungens Kunth	P,G	28315
Alternanthera brasiliana var. villosa (L.) Kuntze	L45	22936
Boraginaceae		
Heliotropium indicum L.	F, P, L45	29846
Heliotropium procumbens Mill.	P, L45	28316
Ceratophyllaceae		
Ceratophyllum sp.	F, P	28847
Convolvulaceae		
Ipomoea sp.	P	28848
Cyperaceae		
Eleocharis filiculmis Kunth	P	1720
Eleocharis elegans (H. B. K.) Roem. & Schult.	P	28310
Eleocharis sp.	P	29849
Cyperus aff. *esculentus* L.	G	25265
Cyperus sp.	F, P, L45,G	28312
Oxycaryum cubense (Poepp. & Kunth) Lye	F	28311
Euphorbiaceae		
Caperonia castaneifolia (L.) A. St.-Hil.	F, P, G	29850
Fabaceae		
Chamaecrista patellaria (DC).	L45	506
Mimosa aff. *setosa* Benth.	F, G	12726
Mimosa cf. *pigra* L.	L45	17473
Mimosa invisa	P, L45, G, M	10698
Mimosa sp.	F, P, G, M, BM	*
Senna obtusifolia (L.) H.S. Irwin & Barneby	G	27912
Haloragaceae		
Myriophyllum aquaticum (Vell.) Verdc.	F	396
Hydrocharitaceae		
Egeria densa (Planch.) Casp.	F	28326
Hydroleaceae (Hydrophyllaceae)		
Hydrolea spinosa L.	G	23144
Lamiaceae		
Leonotis nepetaefolia (R. Br.) W.T. Aiton	G	23147
Lentibulariaceae		
Utricularia foliosa L.	F	28317
Utricularia warmingii Kamiénski	F	29851
Utricularia pusilla Vahl	G	8674
Lythraceae		
Cuphea sp.	G	2518
Malvaceae		
Hibiscus striatus Cav.	P	23165
Pavonia sp.	G	10854
Waltheria indica L.	L45	29471
Nymphaeaceae		
Nymphaea amazonum Mart. & Zucc.	F, P, L45, M	29853
Onagraceae		
Ludwigia leptocarpa (Nutt.) H. Hara	F	29853
Ludwigia octovalvis (Jacq.) P.H. Raven	L45	28318
Ludwigia aff. *elegans* (Cambess.) H. Hara	G	29854
Poaceae		
Pennisetum americanum (L.) Leeke	P	*
Brachiaria sp.	F	29855
Panicum aff. *dichotomiflorum* Michx.	L45	29856
Hymenachne amplexicaulis (Rudge) Nees	L45, G	29857
Setaria geniculata P. Beauv.	L45	19480
Echinochloa crusgalli (L.) P. Beauv.	P	985
Echinochloa polystachya (Kunth) Hitchc.	F, G	29858
Paspalum urvillei Steud.	P	984
Polygonaceae		
Polygonum ferrugineum Wedd.	F, P, L45, G	234
Polygonum hydropiperoides Michx.	P, L45, G, M	28319
Polygonum punctatum Elliot	L45	29859
Polygonum lapathifolium L.	M	29860
Polygonum sp.	P, G	1725
Pontederiaceae		
Eichhornia crassipes (Mart.) Solms	F, P, L45, G, M, BM	29862
Eichhornia azurea (Sw.) Kunth	F, BM	29861
Pontederia sp.	P	*
Salviniaceae		
Salvinia sp.	F, P, L45, BM	29863
Plantaginaceae (Scrophulariaceae)		
Scoparia dulcis L.	P	13203
Stemodia trifoliata (Link) Reichb.	L45	28320
Verbenaceae		
Lippia alba (Mill.) N.E.Br.	P,G	28321

* Material that was damaged.

Acknowledgments: We are grateful to Oscar A. Shibatta, Lilian Casatti, Antonio F. M. Camargo, and anonymous referees for valuable suggestions; to Fernando R. Carvalho, Fernando L. R. Souza, and Luiz G. G. da Silveira for help in field; to Ademir O. Veschi for technical assistance; to Carlos Daghlian for revision of the English text; to 4º Batalhão de Polícia Ambiental de São José do Rio Preto for logistical support for collecting. This research was partly supported by a CNPq (Conselho Nacional de Desenvolvimento Científico e Tecnológico) personal grant to the first author (142.180/2005-0) and by FAPESP (Fundação de Amparo à Pesquisa do Estado de São Paulo) (04/00545-8) grant to second author.

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Received: July 2009
Revised: October 2009
Accepted: January 2010
Published online: March 2010
Editorial responsibility: Angelo Gilberto Manzatto